

# CURRICULUM VITAE: ROBERT I. SAYE

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## Education

University of California, Berkeley	2008–2013
Ph. D. Applied Mathematics	
Advisor: James A. Sethian	
Thesis: <i>The Voronoi Implicit Interface Method with Applications to Multiphase Fluid Flow and Multiscale Modelling of Foam Dynamics</i>	
The Australian National University (ANU)	2004–2007
Bachelor of Philosophy (Honours) with First Class Honours	
Specialising in applied mathematics and computational science	
Advisor: Stephen Roberts	

## Positions

Lawrence Berkeley National Laboratory, <i>Luis W. Alvarez Postdoctoral Fellow</i>	2013–present
University of California, Berkeley, <i>Graduate Student Researcher</i>	2008–2013
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Melbourne, Australia, <i>Full-time research scientist</i>	2008

## Fellowships and Awards

Luis W. Alvarez Postdoctoral Fellowship	2013–present
International Science & Engineering Visualization Challenge, Science and NSF Honorable Mention for poster <i>The Life Cycle of a Bubble Cluster</i>	2014
Bernard Friedman Memorial Prize in Applied Mathematics, UC Berkeley	2013
Cozzarelli Prize, <i>Proceedings of the National Academy of Sciences</i>	2011
Sir Keith Murdoch Fellowship, American Australian Association	2011–2012
University Medal in Mathematics, ANU	2007
Boyapati Computer Science and Mathematics Honours Scholarship, ANU	2007
Boyapati Computer Science and Mathematics Award, ANU	2006
Hanna Neumann Prize for Mathematics, ANU	2006
Bachelor of Philosophy Undergraduate Scholarship, ANU	2004–2006

## Research Interests

Broadly: evolving interface problems, multi-physics coupling, multi-scale physics, numerical methods  
Specifically: high-order accurate algorithms for implicit interface methods; simulation of multiple evolving interfaces coupled to physics; foams, fluid flow, fluid-structure interaction; high performance computing methods, massively parallel simulations, multigrid techniques; level set methods, shape optimisation

## Publications

R. I. Saye, *Interfacial gauge methods for incompressible fluid flow*, **Science Advances**, **2**(6), 1–14 (2016)  
[doi:10.1126/sciadv.1501869](https://doi.org/10.1126/sciadv.1501869)

R. I. Saye and J. A. Sethian, *Multiscale modelling of evolving foams*, *Journal of Computational Physics*, **315**, 273–301 (2016) [doi:10.1016/j.jcp.2016.02.077](https://doi.org/10.1016/j.jcp.2016.02.077)

## Publications (cont.)

- R. I. Saye, *High-Order Quadrature Methods for Implicitly Defined Surfaces and Volumes in Hyperrectangles*, SIAM Journal on Scientific Computing, **37**(2), A993–A1019 (2015) [doi:10.1137/140966290](https://doi.org/10.1137/140966290)
- R. I. Saye, *High-order methods for computing distances to implicitly defined surfaces*, Communications in Applied Mathematics and Computational Science, **9**(1), 107–141 (2014) [doi:10.2140/camcos.2014.9.107](https://doi.org/10.2140/camcos.2014.9.107)
- R. I. Saye and J. A. Sethian, *Multiscale Modeling of Membrane Rearrangement, Drainage, and Rupture in Evolving Foams*, *Science*, **340**(6133), 720–724 (2013) [doi:10.1126/science.1230623](https://doi.org/10.1126/science.1230623)
- R. I. Saye, *An algorithm to mesh interconnected surfaces via the Voronoi interface*, Engineering with Computers, **31**(1), 123–139 (2013) [doi:10.1007/s00366-013-0335-9](https://doi.org/10.1007/s00366-013-0335-9)
- R. I. Saye and J. A. Sethian, *Analysis and applications of the Voronoi Implicit Interface Method*, Journal of Computational Physics, **231**(18), 6051–6085 (2012) [doi:10.1016/j.jcp.2012.04.004](https://doi.org/10.1016/j.jcp.2012.04.004)
- R. I. Saye and J. A. Sethian, *The Voronoi Implicit Interface Method and Computational Challenges in Multiphase Physics*, Milan Journal of Mathematics, **80**(2), 369–379 (2012) [doi:10.1007/s00032-012-0187-6](https://doi.org/10.1007/s00032-012-0187-6)
- R. I. Saye and J. A. Sethian, *The Voronoi Implicit Interface Method for computing multiphase physics*, Proceedings of the National Academy of Sciences, **108**(49), 19498–19503 (2011) [doi:10.1073/pnas.1111557108](https://doi.org/10.1073/pnas.1111557108)
- R. I. Saye, *A Navier-Stokes Teaching Module* (online); a tutorial on the numerical solution of the incompressible Navier-Stokes equations (2006)

## Submitted Articles

- R. I. Saye, *Implicit mesh discontinuous Galerkin methods and interfacial gauge methods for high-order accurate interface dynamics, with applications to surface tension dynamics, rigid body fluid-structure interaction, and free surface flow*, Journal of Computational Physics (submitted September 2016; 72 pages, 41 figures, 7 algorithms)

## In Proceedings

- R. I. Saye and J. A. Sethian, *New Interface Methods for Tracking Multiphase Physics*, in F. Ancona, A. Bressan, P. Marcati, A. Marson (eds.) *Hyperbolic Problems: Theory, Numerics, Applications*. Proceedings of the 14th International Conference on Hyperbolic Problems (Padova, 2012). AIMS Series on Applied Mathematics **8**, 81–87 (2014)
- R. I. Saye and J. A. Sethian, *Voronoi Implicit Interfaces: Method and Applications*, in C. M. Elliott, Y. Giga, M. Hinze, V. Styles (eds.) *Interfaces and Free Boundaries: Analysis, Control and Simulation*. Oberwolfach Reports **10**(1), 867–950 (2013) [doi:10.4171/OWR/2013/15](https://doi.org/10.4171/OWR/2013/15)
- R. I. Saye and J. A. Sethian, *Applications of the Voronoi Implicit Interface Method*, in M. Hintermüller, G. Leugering, J. Sokolowski (eds.) *Mini-Workshop: Geometries, Shapes and Topologies in PDE-based Applications*. Oberwolfach Reports **9**(4), 3375–3415 (2012) [doi:10.4171/OWR/2012/57](https://doi.org/10.4171/OWR/2012/57)

## Research Grants

- Principal Investigator – Laboratory Directed Research and Development (LDRD) program, LBNL  
*High-Order Implicit Interface Methods for Complex Fluid Flow and Multiple Interface Dynamics* 2013–2015
- Principal Investigator – High Performance Computing for Manufacturing, US Dept. of Energy,  
*Modeling Paint Behavior During Rotary Bell Atomization*, with PPG, Inc. 2016–2017

## News Articles

- [New Math Captures Fluids in Unprecedented Detail](#), Advanced Scientific Computing Research, U.S. Department of Energy Office of Science 26 Aug 2016
- [New Mathematics Accurately Captures Liquids and Surfaces Moving in Synergy](#), LBL Newscenter *wyborcza Nauka dla każdego* (“Science for everyone”), a Polish newspaper 10 Jun 2016
- [2013 Visualization Challenge](#), *Science*, **343**(6171) (2014) [doi:10.1126/science.343.6171.600](https://doi.org/10.1126/science.343.6171.600) 16 Jun 2015
- 7 Feb 2014

<a href="#">Computing Sciences Supported Research Named Among 2013's Best</a> , Berkeley Lab CS News	20 Dec 2013
<a href="#">Our favourite pictures of 2013</a> , IOP Physics World	18 Dec 2013
<a href="#">Multiscale Modeling of Foams</a> , SIAM News	1 Nov 2013
Media releases relating to my Science paper co-authored with J.A.Sethian:	May 2013
<a href="#">Revealed! The Mysteries of Bubbles – and Clouds Too</a> , Time.com	
<a href="#">When one bubble pops, why do others form around it? Unlocking a bubble mystery</a> , The Washington Post	
<a href="#">Physics Get Frothy as Mathematicians Dissect Mister Bubble</a> , Scientific American	
<a href="#">Pinning down the physics of bubbles</a> , Los Angeles Times	
<a href="#">Heady mathematics: Describing popping bubbles in a foam</a> , Berkeley Newscenter	
<a href="#">Mathematics of Popping Bubbles in a Foam</a> , LBL Newscenter	
<a href="#">ScienceShot: The Life Cycle of a Bubble</a> , Science AAAS	
<a href="#">Can't Pop This: Bubble Scientists Reveal the Physics of Soap</a> , KQED Science	
<a href="#">Unlocking secret lives of bubbles yields perfect foam</a> , NewScientist	
<a href="#">Working Up a Lather</a> , AMS Mathematical Moments	
<a href="#">Berkeley Lab Mathematicians Win Cozzarelli Prize</a> , LBL Newscenter	21 Feb 2012

## Invited Seminars

Computational Research Division, Lawrence Berkeley National Laboratory	February 6, 2013
Computational Research Division, Lawrence Berkeley National Laboratory	October 23, 2012
Scientific Computing and Matrix Computations Seminar, UC Berkeley	March 21, 2012
Department of Mathematics, Australian National University	November 28, 2011
Applied Mathematics Seminar, UC Berkeley	September 21, 2011

## Conference Presentations

<i>High-Order Quadrature on Implicitly Defined Domains, with application to embedded boundary discontinuous Galerkin methods</i> , SIAM CSE15, Salt Lake City	March 14–18, 2015
<i>Thin-Film Equations for a Soap Bubble Foam</i> , ICIAM 2011 – 7th International Congress on Industrial and Applied Mathematics, Vancouver	July 18–22, 2011

## Graduate Mentoring

Danielle Maddix, now at Stanford ICME	2012 – 2014
Research project: <i>Multi-region shape optimisation using the Voronoi Implicit Interface Method</i>	
Ben Preskill, UC Berkeley	2012 – 2013
Research project: <i>Mechanical and numerical modelling of cell clusters</i>	

## Professional Activities

Journal reviewer: Journal of Computational Physics, SIAM Journal on Scientific Computing, Proceedings A, Communications in Applied Mathematics and Computational Science, Transactions on Graphics, Eurographics	
American Australian Association (AAA) Fellowship application judge	2016
Member of the Society for Industrial and Applied Mathematics	2008–present

Last updated 19 Nov 2016